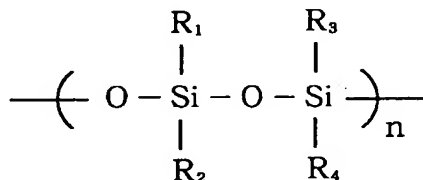CLAIMS

1. A field effect transistor having an organic semiconductor layer, comprising:

an organic semiconductor layer containing at
5   least porphyrin; and

a layer composed of at least a polysiloxane compound, the layer being laminated on the organic semiconductor layer so as to be in intimate contact with the organic semiconductor layer.

10

2. The field effect transistor according to claim 1, wherein the polysiloxane compound is represented by the following general formula (1):
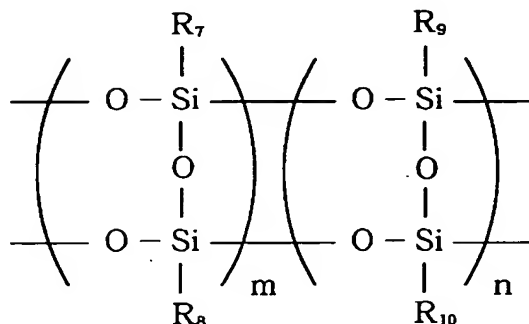
General formula (1)

$$-\left(\!\!\!-\, O - \underset{\underset{R_2}{|}}{\overset{\overset{R_1}{|}}{Si}} - O - \underset{\underset{R_4}{|}}{\overset{\overset{R_3}{|}}{Si}} \!\!\!-\right)_{\!\!n}-$$

15

(In the formula, R_1 to R_4 each represent a substituted or unsubstituted alkyl or alkenyl group having 1 to 5 carbon atoms, a substituted or unsubstituted phenyl group, or a siloxane unit. R_1 to R_4 may be identical
20   to or different from one another. n represents an integer of 1 or more.).

3. The field effect transistor according to claim 1, wherein the polysiloxane compound comprises

a polysiloxane compound represented by the following
general formula (2) and/or the following general
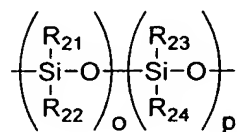formula (6):

General formula (2)

$$\left(\!\!\left(\begin{array}{c} R_7 \\ | \\ O-Si \\ | \\ O \\ | \\ O-Si \\ | \\ R_8 \end{array}\right)_m\!\!\left(\begin{array}{c} R_9 \\ | \\ O-Si \\ | \\ O \\ | \\ O-Si \\ | \\ R_{10} \end{array}\right)_n\right)$$

5

(In the formula, R_7 to R_{10} each represent a
substituted or unsubstituted alkyl or alkenyl group
having 1 to 5 carbon atoms, or a substituted or
unsubstituted phenyl group. R_7 to R_{10} may be
10 identical to or different from one another. m and n
each represent an integer of 0 or more, and a sum of
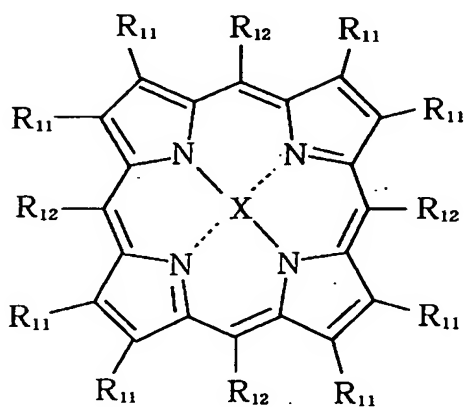m and n is an integer of 1 or more.)

General formula (6):

$$\left(\begin{array}{c} R_{21} \\ | \\ Si-O \\ | \\ R_{22} \end{array}\right)_o\left(\begin{array}{c} R_{23} \\ | \\ Si-O \\ | \\ R_{24} \end{array}\right)_p$$

15 (In the formula, R_{21} to R_{24} each represent a
substituted or unsubstituted alkyl or alkenyl group
having 1 to 5 carbon atoms, or a substituted or
unsubstituted phenyl group. R_{21} to R_{24} may be
identical to or different from one another. o and p
20 each represent an integer of 0 or more, and a sum of

o and p represents an integer of 1 or more.).

4. The field effect transistor according to any
one of claims 1 to 3, wherein the porphyrin is
represented by the following general formula (3):
General formula (3)

$$R_{11} \quad R_{12} \quad R_{11}$$

(In the formula, R_{11}'s represent at least one kind
selected from the group consisting of a hydrogen atom,
a halogen atom, a hydroxyl group, or an alkyl,
oxyalkyl, thioalkyl, or alkylester group having 1 to
12 carbon atoms, and R_{11}'s may be identical to or
different from one another. In addition, adjacent
R_{11}'s may form an aromatic ring which may have a
substituent. In addition, the adjacent R_{11}'s may be
connected to another porphyrin ring which may have a
substituent through the formed aromatic ring. R_{12}'s
represent at least one kind selected from the group
consisting of a hydrogen atom and an aryl group which
may have a substituent. R_{12}'s may be identical to or

different from one another. X represents a hydrogen atom or a metal atom.).

5. The field effect transistor according to any one of claims 1 to 4, wherein at least one pair of the adjacent R_{11}'s in the general formula (3) forms an aromatic ring.

6. The field effect transistor according to any one of claims 1 to 5, wherein the aromatic ring formed by the at least one pair of the adjacent R_{11}'s in the general formula (3) is obtained by heating a precursor having a bicyclo[2.2.2]octadiene skeleton structure which may have a substituent.

7. The field effect transistor according to any one of claims 1 to 6, wherein Bragg angles (2θ) of CuKα X-ray diffraction in the organic semiconductor layer have peaks at 8.3° ± 0.2°, 10.1° ± 0.2°, 11.8° ± 0.2°, and 14.4° ± 0.2°.

8. The field effect transistor according to any one of claims 1 to 6, wherein Bragg angles (2θ) of CuKα X-ray diffraction in the organic semiconductor layer have peaks at 8.4° ± 0.2°, 11.9° ± 0.2°, and 16.9° ± 0.2°.
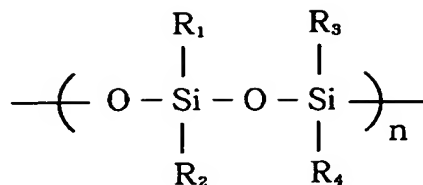
9. The field effect transistor according to any one of claims 1 to 6, wherein Bragg angles (2θ) of CuKα X-ray diffraction in the organic semiconductor layer have peaks at 7.2° ± 0.2°, 7.8° ± 0.2°, 11.7° ±

5   0.2°, and 23.5° ± 0.2°.

10. The field effect transistor according to any one of claims 1 to 6, wherein Bragg angles (2θ) of CuKα X-ray diffraction in the organic

10   semiconductor layer have peaks at 7.3° ± 0.2°, 7.8° ± 0.2°, 11.7° ± 0.2°, and 19.6° ± 0.2°.

11. A method of producing a field effect transistor having an organic semiconductor layer,

15   comprising the step of laminating an organic semiconductor layer containing at least porphyrin and a layer composed of at least a polysiloxane compound in such a manner that the layers are in intimate contact with each other.

20

12. The method of producing a field effect transistor according to claim 11, wherein the polysiloxane compound is represented by the following general formula (1):
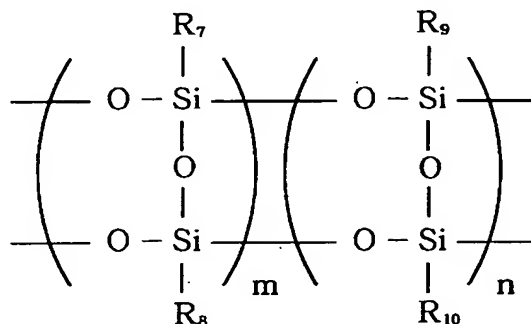
25

General formula (1)

$$-\left(\!\!\begin{array}{c} R_1 \\ | \\ O-Si-O-Si \\ | \\ R_2 \end{array}\!\!\begin{array}{c} R_3 \\ | \\ \\ | \\ R_4 \end{array}\!\!\right)_{\!\!n}$$

(In the formula, R_1 to R_4 each represent a substituted
or unsubstituted alkyl or alkenyl group having 1 to 5

5   carbon atoms, a substituted or unsubstituted phenyl
group, or a siloxane unit. R_1 to R_4 may be identical
to or different from one another. n represents an
integer of 1 or more.).

10   13. The method of producing a field effect
transistor according to claim 11, wherein the
polysiloxane compound comprises a polysiloxane
compound represented by the following general formula
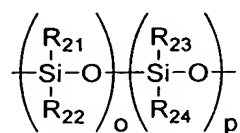(2) and/or the following general formula (6):

15   General formula (2)

$$\left(\!\!\begin{array}{c} R_7 \\ | \\ O-Si \\ | \\ O \\ | \\ O-Si \\ | \\ R_8 \end{array}\!\!\right)_{\!\!m}\!\!\left(\!\!\begin{array}{c} R_9 \\ | \\ O-Si \\ | \\ O \\ | \\ O-Si \\ | \\ R_{10} \end{array}\!\!\right)_{\!\!n}$$

(In the formula, R_7 to R_{10} each represent a
substituted or unsubstituted alkyl or alkenyl group

having 1 to 5 carbon atoms, or a substituted or

unsubstituted phenyl group. R_7 to R_{10} may be

identical to or different from one another. m and n

each represent an integer of 0 or more, and a sum of

5   m and n is an integer of 1 or more.)

General formula (6)

$$\left(\begin{array}{c} R_{21} \\ -Si-O- \\ R_{22} \end{array}\right)_o \left(\begin{array}{c} R_{23} \\ -Si-O- \\ R_{24} \end{array}\right)_p$$

(In the formula, R_{21} to R_{24} each represent a

substituted or unsubstituted alkyl or alkenyl group

10   having 1 to 5 carbon atoms, or a substituted or

unsubstituted phenyl group. R_{21} to R_{24} may be

identical to or different from one another. o and p

each represent an integer of 0 or more, and a sum of
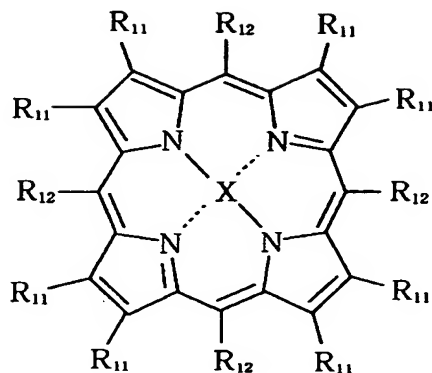
o and p is an integer of 1 or more.).

15

        14. A method of producing a field effect

transistor according to any one of claims 11 to 13,

wherein the porphyrin is represented by the following

general formula (3):

20

·25

General formula (3)

(In the formula, R_{11}'s represent at least one kind
selected from the group consisting of a hydrogen atom,
5 a halogen atom, a hydroxyl group, or an alkyl,
oxyalkyl, thioalkyl, or alkylester group having 1 to
12 carbon atoms, and R_{11}'s may be identical to or
different from one another. In addition, adjacent
R_{11}'s may form an aromatic ring which may have a
10 substituent. In addition, the adjacent R_{11}'s may be
connected to a porphyrin ring which may have a
substituent through the formed aromatic ring. R_{12}'s
represent at least one kind selected from the group
consisting of a hydrogen atom and an aryl group which
15 may have a substituent. R_{12}'s may be identical to or
different from one another. X represents a hydrogen
atom or a metal atom.).

15. The method of producing a field effect
20 transistor according to any one of claims 11 to 14,
wherein at least one pair of the adjacent R_{11}'s in the

general formula (3) forms an aromatic ring.

16. The method of producing a field effect transistor according to any one of claims 11 to 15, wherein the aromatic ring formed by the at least one pair of the adjacent R_{11}'s in the general formula (3) is obtained by heating a precursor having a bicyclo[2.2.2]octadiene skeleton structure which may have a substituent.

17. The method of producing a field effect transistor according to any one of claims 11 to 16, wherein Bragg angles (2θ) of CuKα X-ray diffraction in the organic semiconductor layer form peaks at 8.3° ± 0.2°, 10.1° ± 0.2°, 11.8° ± 0.2°, and 14.4° ± 0.2°.

18. The method of producing a field effect transistor according to any one of claims 11 to 16, wherein Bragg angles (2θ) of CuKα X-ray diffraction in the organic semiconductor layer form peaks at 8.4° ± 0.2°, 11.9° ± 0.2°, and 16.9° ± 0.2°.

19. The method of producing a field effect transistor according to any one of claims 11 to 16, wherein Bragg angles (2θ) of CuKα X-ray diffraction in the organic semiconductor layer form peaks at 7.2° ± 0.2°, 7.8° ± 0.2°, 11.7° ± 0.2°, and 23.5° ± 0.2°.

20. The method of producing a field effect transistor according to any one of claims 11 to 16, wherein Bragg angles (2θ) of CuKα X-ray diffraction in the organic semiconductor layer form peaks at 7.3°

5 ± 0.2°, 7.8° ± 0.2°, 11.7° ± 0.2°, and 19.6° ± 0.2°.

21. A method of producing a laminated member having an organic semiconductor layer, comprising the steps of:

10   providing a crystallization promoting layer on a substrate;

      providing an organic semiconductor precursor on the crystallization promoting layer; and

      applying energy to the organic semiconductor

15 precursor to form a layer composed of an organic semiconductor.

22. The method of producing a laminated member according to claim 21, wherein the crystallization

20 promoting layer has a function of promoting bonding between crystal grains.

23. The method of producing a laminated member according to claim 21 or 22, wherein the energy

25 comprises light energy or heat energy.

24. The method of producing a laminated member

according to any one of claims 21 to 23, wherein the step of applying energy to the organic semiconductor precursor to form the layer composed of the organic semiconductor includes a step of allowing the organic

5   semiconductor precursor to cause an elimination reaction.

25. The method of producing a laminated member according to claim 24, wherein the elimination

10   reaction comprises a retro Diels-Alder reaction.

26. The method of producing a laminated member according to claim 24 or 25, wherein the energy is continuously applied even after completion of the

15   elimination reaction.

27. The method of producing a laminated member according to any one of claims 21 to 26, wherein the step of providing the organic semiconductor precursor

20   comprises a step of applying or printing a solution containing the organic semiconductor precursor.

28. The method of producing a laminated member according to any one of claims 21 to 27, wherein the

25   crystallization promoting layer contains a polysiloxane compound.

29. A method of producing a field effect transistor having an organic semiconductor layer, comprising the steps of:

forming a crystallization promoting layer on a

5 substrate;

providing an organic semiconductor precursor on the crystallization promoting layer; and

providing energy to the organic semiconductor precursor to form the organic semiconductor layer.

10

30. The method of producing a field effect transistor according to claim 29, wherein the crystallization promoting layer has a function of promoting bonding between crystal grains.

15

31. The method of producing a field effect transistor according to claim 29 or 30, wherein the energy comprises light energy or heat energy.

20   32. The method of producing a field effect transistor according to any one of claims 29 to 31, wherein the step of applying energy to the organic semiconductor precursor to form a layer composed of an organic semiconductor includes a step of allowing

25 the organic semiconductor precursor to cause an elimination reaction.

33. The method of producing a field effect transistor according to claim 32, wherein the elimination reaction comprises a reverse Diels-Alder reaction.

5

34. The method of producing a field effect transistor according to claim 32 or 33, wherein the energy is continuously applied even after completion of the elimination reaction.

10

35. The method of producing a field effect transistor according to any one of claims 29 to 34, wherein the step of providing the organic semiconductor precursor comprises a step of applying

15 or printing a solution containing the organic semiconductor precursor.

36. The method of producing a field effect transistor according to any one of claims 29 to 35,

20 wherein the crystallization promoting layer contains a polysiloxane compound.

37. A field effect transistor having an organic semiconductor layer, comprising:

25   a substrate;

a crystallization promoting layer on the substrate; and

the organic semiconductor layer in contact with
the crystallization promoting layer.